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湘西中寒武世多节类三叶虫新属种*

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内 容 提 要

描记湘西江南斜坡带中寒武统花桥组的多节类三叶虫4新属7新种:*Changqingia laevis* sp. nov.,*Fissanomocarella paibiensis* gen. et sp. nov.,*Huayuania subcalva* gen. et sp. nov.,*Luaspis decorosa* gen. et sp. nov.,*Paranomocarella fortis* sp. nov.,*Wangcunia wangcunensis* gen. et sp. nov. 和 *Zhujia hunanensis* sp. nov.。*Fissanomocarella* gen. nov. 属 Anomocarellidae 科;*Wangcunia* gen. nov. 和 *Huayuania* gen. nov. 分别存疑地归入 Papyraspidae 科和 Anomocarellidae 科;*Luaspis* gen. nov. 的科级分类位置未定。所有新属种与华北和东北南部中寒武世动物群关系较密切,是斜坡相混生动物群的重要分子。

关键词 湘西 中寒武统 花桥组 多节类三叶虫

湘西是我国中寒武世三叶虫最为丰富的产地之一。目前所知,除产有极丰富的球接子三叶虫外,还有成分复杂的多节类三叶虫。这一地区的中寒武世三叶虫,先后有叶戈洛娃等(1963)、刘义仁(1977,1982)和杨家隼(1978)作过研究。1981年,湖南省地矿局405队区调分队在进行1∶5万区域地质调查时,在花垣县境内排碧乡实测了寒武系剖面,所采的三叶虫化石曾由笔者之一(彭善池)鉴定。其后,我们对该剖面的三叶虫做过多次补充采集。近年中笔者等又实测了永顺王村中—上寒武统剖面。结果发现,在两地采获的大量三叶虫材料中,有许多以往尚未描记的新属种。本文特对其中中寒武世部分多节类三叶虫新属种作一报道,计有4新属7新种:*Changqingia laevis* sp. nov.,*Fissanomocarella paibiensis* gen. et sp. nov.,*Huayuania subcalva* gen. et sp. nov.,*Luaspis decorosa* gen. et sp. nov.,*Paranomocarella fortis* sp. nov.,*Wangcunia wangcunensis* gen. et sp. nov.,*Zhujia hunanensis* sp. nov.

湘西北江南斜坡带的中寒武统划分为两个组,即下伏敖溪组和上覆花桥组。敖溪组是白云岩为主的沉积,目前尚未发现三叶虫化石;花桥组为斜坡相沉积,以泥质纹层灰岩为主。本文材料全部采自花桥组。排碧和王村两地的花桥组有较大差异,主要区别是前者的泥质纹层

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灰岩的背景沉积中夹有许多浅色、异地来源的砾屑灰岩夹层，后者则绝无砾屑灰岩夹层发育，显见两地处于斜坡的不同部位。尽管如此，从现有的三叶虫材料看，两地花桥组的三叶虫分带现象却是相似的，初步研究自下而上可划分为4个三叶虫带：1)*Ptychagnostus atavus* 带；2)*Ptychagnostus punctuosus* 带；3)*Goniagnostus nathorsti* 带；4)*Lejopyge laevigata* 带。其中 *Lejopyge laevigata* 带或许可作进一步的划分。详细的生物地层层序有待进一步研究。

历年的野外工作均得到405队的大力协助。李军、王化羽、王根贤、刘五一、韩跃军等参加了野外工作。成文过程中承蒙张文堂教授、袁金良教授参与讨论并提出宝贵意见。图影由胡尚卿摄制。对上述单位和个人，笔者深表感谢。

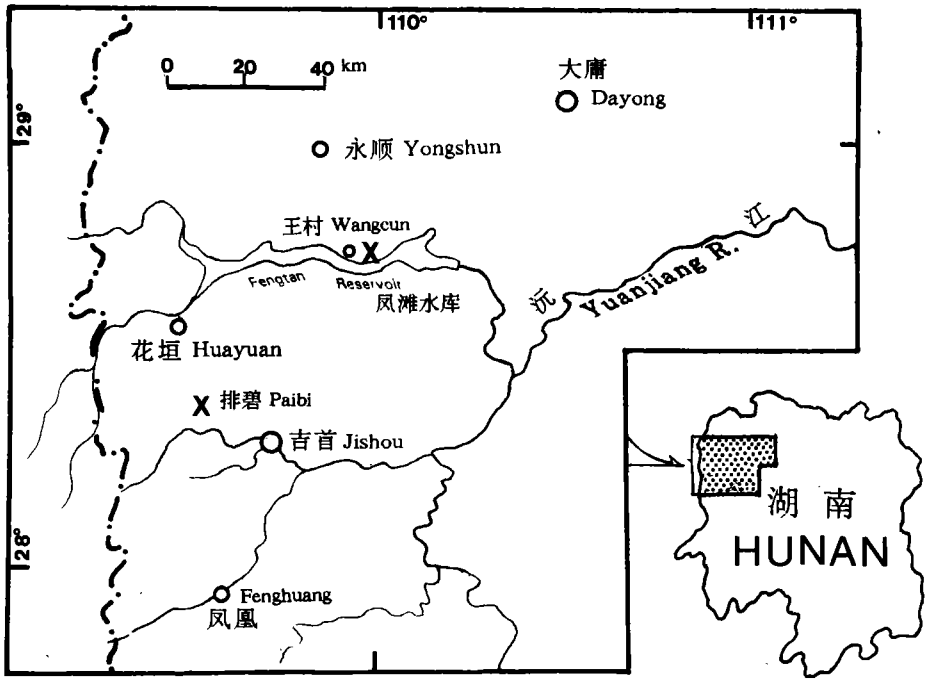

插图1 化石产地永顺王村剖面及花垣排碧剖面位置图

Map showing location of the Wangcun and Paibi sections (indicated by X) in Western Hunan, from which the present new taxa were yielded

属种描述

？纸草虫科 ？Family Papyriaspididae Whitehouse, 1939

王村虫属(新属) Genus *Wangcunia* gen. nov.

模式种 *Wangcunia wangcunensis* gen. et sp. nov.

特征 头鞍相对较大，向前微收缩，前端尖圆。鞍前区窄(纵向)。面线前支近平行前伸，作均匀的弧形。尾部分节多，与头盖长度近相等。

讨论 Öpik(1963, p. 149)认为，Papyriaspididae 科隶属于 Ptychoparacea 超科，它与

该超科中的 Ptychopariidae 科的唯一区别在于其胸部分节特别多。实际上这一科的三叶虫与 Olenacea 超科的三叶虫有许多相似之处。笔者因而更赞成 Henningsmoen (in Moore, 1959)原先将它置于 Olenacea 超科的观点。新属的特征表明，它只有可能属于 Olenidae 科或者属 Papyriaspididae 科。在当前标本中，仅发现一枚有 8 个胸节的背甲标本，根据其头盖纵向长度仅为最大的一枚头盖标本长度的 4/10，尾部的长度仅为最大尾部标本的 3/10，推测其很可能是一处于分节期的个体。因此，新属胸节的确切数目目前尚不能确定。但由于新属的尾部分节可多达 14 节，就背甲整体而言，也应是分节多的三叶虫。从新属的形态看，其头盖除头鞍比例较大外，总体特征与归入 Papyriaspididae 科的某些属，如 *Papyriaspis* Whitehouse, 1939, *Pianaspis* Saito et Sakakura, 1936, *Prohedinia* Lermontova et Tchernysheva, 1950, *Tosotychia* Öpik, 1961 等均较相近，如头盖外形横宽，外边缘窄且具后伸体(plectrum)，眼脊发育且微向后斜，鞍沟发育、颈前沟深而强烈后斜等。Papyriaspididae 科各属尾部大小变化较大，*Pianaspis*, *Prohedinia* 等属的尾部极小(卢衍豪等，1989，图版 20，图 4；Соловьев, 1966, табл. 1, фиг. 1, 2; табл. 2, фиг. 5)，而 *Papyriaspis* 的尾部就相对较大。新属有窄而清楚的侧边缘，中轴长、末端与后边缘相连，这些特征，均可与 *Papyriaspis* 相比较。

综上所述，虽然目前新属的胸部分节情况尚不甚明了，但根据其背甲的综合特征，笔者暂将其置入 Papyriaspididae 科。新属与 Papyriaspididae 科各属的重要区别有两点：(1)头鞍比例较大，前端尖圆而不近截切；(2)尾部较大而分节较多。

时代分布　湖南永顺，中寒武世 *Ptychagnostus punctuosus* 带下部。

王村王村虫(新属、新种)　*Wangcunia wangcunensis* gen. et sp. nov.

(图版 Ⅰ，图 1—11，12b，13)

特征　与属征相同。

描述　头盖亚梯形，除头鞍略凸起外，其余部分近平坦，长度略小于两眼叶间的宽度。头鞍两则微向前收缩，前端尖圆，长度(包括颈环)约为头盖全长的 4/5，具 4 对头鞍沟：颈前沟深，自背沟强烈后斜；第二对鞍沟稍浅，向内微向后斜；多数标本的第三、四对鞍沟因保存关系不易观察，但一枚最小的头盖(图版 Ⅰ，图 5)上可见第三对鞍沟向内略向前斜伸，其长度和深度与第二对鞍沟相仿；第四对鞍沟极短，位于头鞍前侧角，向内向前伸。颈沟两侧深陷，中部明显变浅，颈环近等宽(纵向)，前部具颈疣。眼叶中等大小，新月形，微歪斜，位于头盖中部，后端与颈前沟相对。固定颊眼区平，宽度(横向)等于或略宽于两眼叶间头鞍宽度的 1/2；眼沟宽浅；眼脊强壮，直或稍弯曲，自背沟向外微向后斜伸。外边缘窄而平，中部宽，两端尖，高于鞍前区，微向后至微向前倾斜，后部具一宽短的后伸体；前边缘沟宽，V 形，在保存较好的标本上(图版 Ⅰ，图 1)，其内能见到极细的、排列不规则的陷坑。鞍前区较外边缘稍宽(纵向)。面线前支近于平行前伸并逐渐圆滑内弯成圆弧状，在靠近轴线部位与前缘相交；后支作宽 S 形，包围一三角形的后侧翼，后支与后缘交点至背沟的距离明显大于颈环的横向长度。后边缘沟直，后边缘窄带状。

活动颊颊区宽，微凸起。边缘沟浅，靠近颊角处微弱；边缘窄，在颊角附近微上凸。颊刺纤细，稍位于颊角之前。

唇瓣亚三角形。中心体前叶强烈凸起，卵形，后侧具不明显的唇瓣斑；后叶新月形，适度

凸起。前翼窄(横向),向背面强烈弯曲。前边缘强烈上翘;侧边缘窄脊状;后边缘极窄。后缘宽弧形后弯。

头盖腹边缘具腹边缘板。

尾部大而平,半椭圆形,前缘横直,前侧角锐角状,长度为前缘宽度的7/10—8/10。中轴细长,适度凸起,徐缓向后收缩,分为一个窄背状的关节半环、11—13个轴节和一个末节。尾轴末端明显上凸,向后迅速降低高度而与后边缘相连。肋区外侧徐缓下降。分为10—13个肋节;肋沟宽浅,直,前面的肋沟横伸,向后依次变为向后外斜伸,前后肋带均呈细线状;间肋沟较窄较浅,最后几对十分微弱。侧边缘窄而平,向后稍变宽。尾部后缘不完整,中部向前弧形凹入。

产地层位 湖南永顺王村,中寒武统花桥组 *Ptychagnostus punctuosus* 带。

沟肋虫科 Family Solenopleuridae Angelin, 1854

长清虫属 Genus *Changqingia* Lu et Zhu, 1983

1983 *Changqingia* Lu et Zhu,仇洪安等,104页。

1987 *Austrosinia* Zhang et Jell, Zhang and Jell,. p. 91.

模式种 *Changqingia shandongensis* Lu et Zhu, 1983

讨论 1987年,张文堂和Jell在整理保存于美国纽约史密森博物馆的我国华北寒武纪三叶虫时,曾以Walcott (1911)描记的 *Solenoparia chalcon* (Walcott, 1911, p. 83, pl. 16, fig. 5)为模式种建立新属 *Austrosinia*。*S. chalcon* 产于辽宁长兴岛中寒武统张夏组,其主要特征是头鞍前区窄而下凹,有微弱中沟,固定颊宽,头鞍前端尖圆、基部宽阔;尾部分节多,外形呈亚三角形。在他们之前,卢衍豪、朱兆玲曾建立一新属 *Changqingia*,认为它与 *Solenoparia* 的区别在于头盖较横宽,头鞍前端尖圆、基部宽阔,鞍前区窄(纵向)而下陷,并具浅而宽的中沟;尾部分节较多、边缘宽。由此可见,*Changqingia* 与 *Austrosinia* 在头盖和尾部方面特征完全一致。同时,*Changqingia* 产于山东泰安中寒武统张夏组,与 *Austrosinia* 的产地相近,层位相当。据此,笔者认为,它应是后者的早出异名。

以往张文堂和Jell (1987, p. 92)归入 *Austrosinia* 中的种,均应转移到 *Changqingia* 属中。此外,产于哈萨克的 *Solenoparia lata* Ivshin (Ившин, 1953. стр. 109, табл. 7, фиг. 21, 21a)以及 *S. suavis* Ivshin 的一些副模标本(Ившин, 1953, стр. 102, табл. 7, фиг. 1—3, 5—8, 15, *non* фиг. 2)亦应归入本属。后者可能代表了本属的一个新种。

时代分布 山东、辽宁中寒武世 *Crepicephalina* 带;湘西中寒武世 *Goniagnostus nathorsti* 带;南朝鲜中寒武世 *Solenoparia* 带;澳大利亚、哈萨克中寒武世晚期。

光滑长清虫(新种) *Changqingia laevis* sp. nov.

(图版Ⅱ,图1—4)

特征 外边缘纵向窄,壳面不具瘤点装饰。

描述 头盖亚长方形,中度凸起,长度为两眼叶间宽度的4/5,前缘平圆。头鞍宽锥形,适度凸起,前端尖圆,为极深的背沟和鞍前沟所限;头鞍沟3对,微弱,但表皮剥落后较为清晰,颈前沟分叉,横Y形;第二对鞍沟位于头鞍中线之前,弧形弯曲,向后内伸展;前一对近

平伸,较眼脊内端稍靠后。颈沟窄而深,外端微向前弯曲;颈环窄(纵向),向两侧迅速变窄,中间偏前具一小颈疣。眼叶中等大小,位于头盖中部偏后,新月形;眼沟宽浅。眼脊明显,自眼叶前端微向前伸并徐缓内弯横越固定颊眼区,接近背沟时强壮程度迅速减弱。外边缘窄(纵向)而凸起,中部较两侧宽;前边缘沟深而窄,横伸或中部微向后拱曲;鞍前区窄(纵向)而凹陷,轴向部位发育宽浅的中沟;固定颊眼区横宽,平缓凸起。面线前支自眼叶前端徐缓向前收缩并逐渐向内弧形弯曲,斜切外边缘;后支直,约呈 45°角向后内斜伸。后侧翼亚三角形,后边缘沟宽深,后边缘脊线状。

比较　这是本属首次在我国南方发现。新种与本属所有已知种的区别在于外边缘相对较窄(纵向),头鞍前缘更为尖圆,表面不具瘤点装饰。

产地层位　湖南花垣排碧,中寒武统花桥组 *Goniagnostus nathorsti* 带。

小无肩虫科　Family Anomocarellidae Hupè, 1953

裂小无肩虫属(新属)　Genus *Fissanomocarella* gen. nov.

模式种　*Fissanomocarella paibiensis* gen. et sp. nov.

特征　外边缘宽平,具宽短的后伸体。鞍前区消失或极窄。头鞍大,强烈凸起(纵、横向),具 4 对鞍沟和边叶(bacculae)。颈环后部上凸且向后延伸,后侧翼横长。尾部后侧边缘向后侧拉长成两叶三角形的宽刺。

讨论　新属头盖和尾部的许多基本特征,如头鞍的形状,后伸体的发育程度,眼叶的形状、大小和位置,尾轴分节状态及肋区构造等与 *Anomocarella*,尤其是其模式种 *A. chinensis* (Walcott)(Zhang and Jell, 1987, p. 177)非常相似。因此,将它置于 Anomocarellidae 科应无问题。新属与 *Anomocarella* 以及其它归入 Anomocarellidae 科诸属的显著不同之处是鞍前区已消失或极窄以及特殊的、分裂为两叶的尾边缘。

华北所产的 *Hsuchuangia* Lu et Zhu(仇洪安等,1983,88 页),其尾部也具向后侧伸展的宽刺,且肋沟伸达宽刺以内,但该属的尾轴粗大,肋区较窄(横向)且缺乏副腹边缘线(paradoublural line)。*Temnoura* Resser et Endo in Kobayashi, 1935, *Koptura* Resser et Endo in Kobayashi, 1935, *Parakoptura* Guo et Duan (郭鸿俊等, 1978), *Lianglangshania* Zhang et Wang(张进林等,1985), *Teratokoptura* Xiang et Zhang (项礼文等,1985)等属的尾部虽然有裂成两叶的边缘,但它们的肋部甚窄(横向),边缘向后而不是向后侧拉伸,在外形上与新属尾部差别甚大;同时,它们尾轴的比例和肋部的构造也与新属不同。

Shergold (1980, pl. 33, figs. 6—9)和 Kobayashi (1962, pl. 3, figs. 20—22)均为 *Haniwoides* 一属指配过后边缘分裂的尾部,但这些尾部的形态和肋区的构造与新属的尾部有很大区别;*Haniwoides* 的头盖则与新属截然不同。

时代分布　湖南西部,中寒武世 *Ptychagnostus atavus* 带。

排碧裂小无肩虫(新属、新种)　*Fissanomocarella paibiensis* gen. et sp. nov.

(图版 Ⅱ,图 5—11;图版 Ⅲ,图 1—3)

特征　与属征相同。

描述　头盖亚方形。背沟清晰,中等深度;头鞍大,相当凸起(纵、横向),两侧平行,前端

浑圆，基部被一对短的、连接背沟和颈沟的斜沟分出一对三角形的边叶；有4对头鞍沟；颈前沟明显，曲折状，向后斜伸，两端变浅，有时内端分叉；第二对鞍沟位于头鞍中部略偏前，近平伸；第三、四两对鞍沟位于头鞍前侧角附近，均向前斜伸。颈沟深，平直或略向后弯；颈环横三角形，后部强烈上凸，中部偏后的位置上有一微弱的颈疣，后缘钝尖，颈环两边有一对浅的、连接颈沟和后缘的斜沟，在外侧分出一对侧叶。眼区窄(横向)，微凸起，宽度约为头鞍宽的1/3，眼叶中等大小，新月形，后端与颈前叶中部相对，前端则与第二对鞍沟相对；眼沟宽浅。眼脊短而直，凸起，强烈后斜，内端伸达第四对头鞍沟处的背沟内。鞍前区消失或极窄；眼前区三角形，向外向下弯曲。外边缘宽(纵向)平，微上翘，在轴向部位的后部略向下凹陷并向后延伸成宽短的后伸体；前边缘沟清晰，在后伸体后略变浅。面线前支约呈50°交角向前扩张，越过前边缘沟后急速内转，呈微外拱的弧形斜切外边缘，在背沟的相对位置与前缘相交；后支近平伸，外端逐渐向后弯曲。后侧翼窄桨状。后边缘沟宽深，后边缘内端极窄，向外逐渐增宽。

尾部长方形，后侧边缘向后侧方向拉伸并向上翘起形成一对翅状宽刺。中轴凸起，长锥状，由浅而平直的环节沟分成一窄脊状的关节半环，6—7个轴节以及一个半圆形的末节，末端稍超过副腹边缘线。肋部宽而凸起，间肋沟微弱，分肋区为6—7个肋叶；肋沟深槽状。间肋沟和肋沟均延伸至宽刺状的边缘之内，但不与侧缘和后缘相交。副腹边缘线为半圆形的脊状凸起，从而在肋区沿其前缘形成一道浅沟。

头盖及尾部表面具极细的褶纹状装饰，眼前区表皮剥落后具细的网纹状装饰。

产地层位 湖南花垣排碧，中寒武统花桥组 *Ptychagnostus atavus* 带。

副小无肩虫属 Genus *Paranomocarella* Yang, 1977

模式种 *Paranomocarella parallela* Yang, 1977

讨论 *Paranomocarella* 的形态与 *Anomocarella* 较为相似。杨家骏(1978, 53页)在讨论它们的区别时认为 *Paranomocarella*"具有头鞍沟，内边缘和固定颊眼前区密布放射状细线，尾甲边缘很宽，边缘上有清楚的肋沟插入。"然而，从目前张文堂和 Jell (1987, p. 177—183)整理的产于我国华北的10余种 *Anomocarella* 的特征看来，上述鉴别特征不足以将这两个属区别开。例如：*Anomocarella* 的模式种 *A. chinensis* Walcott 及 *A. bella* (Resser et Endo)便发育鞍沟；*A. albion* Walcott 和 *A. temunus* (Walcott)有具放射状纹线并连接成网状装饰的眼前区。况且后一特征的明显与否与标本的剥离程度有很大的关系。再者，杨家骏所指的边缘沟实际上应为副腹边缘线，它在 *Anomocarella* 的某些种上也常见发育(Zhang and Jell, 1987, pl. 71, fig. 14; pl. 74, figs. 3, 9, 13; pl. 75, fig. 9)。尽管如此，笔者并不怀疑 *Paranomocarella* 为一独立属。现有材料表明，它与 *Anomocarella* 的重要区别在于头盖的凸起甚低，眼叶较小且更为靠近头鞍(尤其是眼叶后端)，前边缘较为宽大而头鞍比例相对较小，后伸体也更为发育。在尾部方面它的肋区分节较为明显，肋沟及副腹边缘线均较显著。

山西中条山地区中寒武统徐庄组所产的 *Gangdeeria* Zhang et Yuan(张文堂等，1980, 75页)与 *Paranomocarella* 很相像，据笔者对其模式种 *G. neimengguensis* 模式标本的观察(张文堂等，1980，图版8，图10—12)，其正模可能是尚未充分发育的头盖，而副模头盖和尾部的形态与 *Paranomocarella* 极为相似，笔者怀疑这一属可能是 *Paranomocarella* 的晚出异

名,这一问题有待发现更多的山西标本后定论。

时代分布　湖南西部,中寒武世 *Ptychagnostus atavus* 带至 *Lejopyge laevigata* 带下部;四川东北部 *Linguagnostus wanyuanensis-Paranomocarella* 带。

强壮副小无肩虫(新种)　*Paranomocarella fortis* sp. nov.

(图版Ⅰ,图 12a;图版Ⅲ,图 4—13;图版Ⅳ,图 1—4)

特征　前边缘宽阔,外边缘平凸,显著高于鞍前区和眼前区,后伸体强壮,头鞍沟清楚,尾部横宽。

描述　头盖亚长方形,长度显著大于两眼叶间的宽度,具宽阔(纵、横向)的前边缘。头鞍长方形,平缓凸起,前端圆润,有微弱的中脊。背沟弯曲,相互平行。头鞍(包括颈环)约占头盖全长的 3/4,有 4 对头鞍沟(多数标本仅能观察到后 2 对):颈前沟浅,凹陷状,内端分叉;第二对鞍沟明显较颈前沟浅,压痕状,表皮剥落后呈水平状横伸,相对位置在眼叶后端稍后;第三、四对鞍沟极浅,向前向内斜伸。颈沟平直,中部浅,两则加深成浅坑,向外又变浅;颈环窄带状,横向宽度大于头鞍中部宽度,并与头鞍基部一道向外膨凸,中部有一清晰的颈疣。眼叶中等大小,靠近头鞍;眼沟微弱。固定颊眼区宽度略大于头鞍宽的 1/3。眼脊强烈向前斜伸。外边缘宽度(纵向)与鞍前区近相等,平或略上翘,其后有一强壮的后伸体。前边缘沟分化为两支,内端呈 U 形包围后伸体。面线前支强烈向外扩张,越过前边缘沟后向内向前直伸,在背沟的相对位置与前缘相交,继而向后微向内斜切腹边缘,后支近平伸,包围极狭长的后侧翼,后边缘沟宽浅。

唇瓣前缘平弧状,向前弯曲。中心体前叶大,椭圆形,强烈凸起;中沟宽深,后叶新月形,微凸起。前边缘窄,强烈上翘;前翼中等大小,三角形,朝背面强烈弯曲。唇瓣斑浅坑状,微向内陷,侧边缘极窄。

尾部半圆形,前缘宽弧形,前侧角具狭长且强烈下倾的关节面。中轴细长,徐缓向后收缩,具 7—8 个轴节、一关节半环和一个半圆形的末节并向后延伸为短的轴后脊。肋区平缓凸起,向外逐渐下降,接近侧缘又稍向上翘,形成不明显的边缘沟。肋区具明显的副腹边缘线。有 7 个肋节,肋沟宽槽状,在副腹边缘线之外显著变浅,不伸达侧缘。

比较　新种与四川万源所产的 *P. pujiabaensis* Yang et Lin(杨家骏等,1991,161 页,图版 19,图 11—14)较接近,但后者头盖外边缘上有横向凹陷,后伸体较微弱,尾部相对较窄(横向)。四川万源所产的另一个种 *P. transversa* Yang et Lin(杨家骏等,1991,图版 19,图 9,10)同样因其外边缘下凹和后伸体微弱而与新种有别。不过杨家骏等为这个种指配的尾部与新种尾部十分相似,唯一的区别是后者的肋沟在副腹边缘线之外也较显著。新种的头盖前边缘较横宽,尾部中轴较细长,据此可与模式种 *P. parallela* 区别开。

产地层位　湖南花垣排碧、永顺王村;中寒武统花桥组 *Ptychagnostus atavus* 带至 *Lejopyge laevigata* 带。

花垣虫属(新属)　Genus *Huayuania* gen. nov.

模式种　*Huayuania subcalva* gen. et sp. nov.

特征　头盖除前边缘沟较明显外,其余的沟均极浅或消失(鞍沟),头鞍平缓凸起,颈环

具颈疣。外边缘宽(纵向),平缓凸起,无鞍前区。眼叶大,位于头盖后部,后侧翼极窄。尾轴长,副腹边缘线微弱,边缘沟宽浅。环节沟、肋沟均不发育。活动颊不具颊刺。壳面光滑。

讨论 新属壳面光滑、背沟、眼沟、颈沟及鞍沟消退程度较高且缺失鞍前区,是中寒武世比较特征的三叶虫。头盖与光盖虫类三叶虫(leiostegiids)的头盖有相似之处,但从头部表皮剥落后的形态以及尾部外形、关节面的发育程度、边缘的形态和中轴表皮剥落后的分节等特征看,似与 Anomocarellidae 科的三叶虫比较接近。依其头鞍凸起较平缓且向前收缩较强烈、缺失鞍前区以及不具颊刺等特征看,归入该科又似有疑问。

新属与四川万源中寒武统 *Lejopyge laevigata-Clavagnostus* 带所产的 *Dazhuia* Yang et Lin(杨家骏等,1991,154 页)较为相似,不同之处是后者的外边缘平而上翘,其表皮未剥落时,背沟也较清楚。此外,后者的前边缘沟较平直,头鞍前端近于截切,头盖外形和凸起程度也与新属不相同。如果 *Dazhuia* 的头鞍前部的确如杨家骏等描记的那样具有中瘤的话,新属则与它有更大的差别。由于建立 *Dazhuia* 属的依据仅为一枚保存很差的头盖,因此很难与新属作进一步的比较。

新属壳面光滑,亦可与 *Liopeishania* Chang(张文堂,1963,页 473)作一比较,区别在于后者具有窄的鞍前区,眼叶较小,面线前支向外扩张程度较小,头鞍较凸起。

时代分布 湖南花垣;中寒武世 *Lejopyge laevigata* 带中部。

近光滑花垣虫(新属、新种) *Huayuania subcalva* gen. et sp. nov.

(图版Ⅳ,图 5—14;图版Ⅴ,图 1—6)

特征 与属征相同。

描述 头盖亚梯形,长度约为两眼叶间宽度的 4/5,横向平缓凸起,纵向凸度较大,前缘平圆。头鞍微凸起,向前收缩,前端圆润,鞍沟不显。背沟浅。颈沟浅;颈环中部较两侧稍宽,具一明显颈疣。眼区平,向外侧倾斜,眼沟微弱。眼叶大,微歪斜,位于头盖中后部,长度约为头鞍长(不包括颈环)的 1/2。眼脊微弱呈现,向前斜伸,内端靠近头鞍前侧角。无鞍前区。眼前区强烈向下向前倾斜。外边缘中等宽度,平缓凸起,微向前倾斜或平伸,个别小标本外边缘稍向上翘。前边缘沟明显,作弧形向前拱曲。面线前支呈弧形,强烈向外拱曲;后支由眼叶后端向外平伸,并徐缓后弯与头盖后缘相交,其交点到背沟的距离稍大于颈环宽度(横向)的 1/2。后侧翼狭(纵向),后边缘沟浅而直。

头盖表皮剥落后背沟、眼沟和颈沟都十分清楚,但鞍沟仍旧不显。

活动颊侧边缘宽,平缓凸起,前部平伸,后部微向外侧倾斜,颊区窄(横向),颊角尖圆或钝尖,位于头盖后缘稍前。活动颊腹边缘前部极长,前端平直,推测头盖腹边缘的腹边缘板极窄(横向),或腹边缘板缺失,仅具中缝(median suture)。

尾部半圆形,前侧角截切状,具强烈下弯的关节面。中轴长锥状,明显凸起,长度约占尾长的 4/5,后端尖圆,分节不清。表皮剥落后环节沟十分显著,前部的环节沟宽深,向后依次减弱,分中轴为一脊线状关节半环、7 个轴节和一个亚三角形的末节。肋区前边缘沟宽浅;肋沟隐约呈现,表皮剥落后仍十分微弱。副腹边缘线清楚,在轴向部位被中轴阻断。边缘沟为浅的凹陷,侧边缘前部微向外倾斜,后边缘向后平伸或微上翘。腹边缘中等宽度,微凸起,具微弱的纹线,呈同心状与尾部后缘平行。

产地层位　湖南花垣排碧,中寒武统花桥组 *Lejopyge laevigata* 带中部。

原附栉虫科　Family Proashaphiscidae Chang,1963

诸暨虫属　Genus *Zhujia* Ju,1983

模式种　*Zhujia lubrica* Ju in Qiu *et al.*,1983

讨论　鞠天吟(仇洪安等,1983,160 页)建立这一属时,仅展示了一枚头盖和一枚尾部标本,并将其置于 Tsinaniidae 科。本文的材料与这一属的特征较为吻合,似应归入此属之中。由于目前尚难见到模式种的模式标本,本文根据湖南材料的形态,特别是表皮剥落标本的形态特征,将此属改置于 Proashaphiscidae 科。

Zhujia 与华北的 *Lioparella* 非常相似,不同之处是后者眼叶较大,头鞍前端近截切,尾部具 4 对前侧刺。

时代分布　浙江北部,中寒武世;湖南西部,*Ptychagnostus punctuosus* 带。

湖南诸暨虫(新种)　*Zhujia hunanensis* sp. nov.

(图版 Ⅴ,图 7—10)

特征　背沟浅,头鞍轮廓清楚,面线前支明显向前扩张,前边缘沟宽圆,前边缘横向宽度大于两眼间宽度。

描述　头盖近方形,壳面光滑,中度凸起(纵、横向),长度与眼叶间宽度近相等。背沟浅。头鞍适度凸起,轮廓清楚,具微弱的中脊,基部宽,向前迅速收缩,前端圆润,长度(包括颈环)约占头盖全长的 3/4;有 4 对头鞍沟;颈前沟和第二对鞍沟长,向内向后伸,位置分别与眼叶两端相对;第三对浅坑状,不与背沟相连,与眼脊的中点相对或略偏前;第四对位于头鞍前侧角,与背沟相连。颈沟浅而直;颈环宽度(纵向)大致均匀,中部具颈疣。眼叶小,位于头盖中部。眼区微凸,外侧微向外倾斜,横向宽度约为两眼叶间头鞍宽的 1/2。眼脊微弱。斜伸。外边缘中等宽度(纵向),平或微凸起,其中部的宽度近相等,两侧向外变窄。鞍前区宽度与外边缘近相等。前边缘沟浅而明显,作圆弧形向前拱曲。眼前区向前侧方向倾斜。面线前支自眼叶前端向外扩张至前边缘沟后,转为向前向内直伸,在眼叶前端稍偏内的相对位置与前缘相交,后支向后外直伸,接近后边缘沟时明显向后转折,包围梯形的后侧翼,后边缘沟宽浅,直;后边缘内窄外宽(纵向)。

表皮剥落后,鞍前区及眼前翼上能见到微弱的网状装饰,背沟、颈沟及后边缘沟则深而显著,但鞍沟不显或极弱,颈疣和眼脊也仍较微弱,不过个体较小的标本(图版 Ⅴ,图 10a,b)的颈疣和眼脊却较强壮。眼脊的内端接近背沟时迅速消失,不与背沟相连。

比较　新种与模式种 *Zhujia lubrica* Ju 的主要区别在于其面线前支向前扩张而不是平行前伸,因而前边缘横向宽度较后者的宽,背沟也较后者的发育,前边缘沟弯曲程度比较平缓。

新种在面线前支历程、前边缘构造、眼脊发育程度以及头鞍具中脊等方面与华北徐庄组所产的 *Lioparella* 的模式种 *L. walcotti* Kobayashi,1937 (Walcott,1913,p. 191,pl. 18,figs. 2d,2e,non figs. 2,2a—c;Zhang and Jell,1987,pl. 66,fig. 14)十分相似,不同之处是后者的眼叶较大,头鞍前端近于截切。*Zhuozishania typica* Zhang et Yuan(1981,p. 167,pl. 3,figs.

1,2)最近已被张文堂和 Jell(1987,p. 160)转移到 *Lioparella* 属。它与新种的区别在于鞍前区较宽,眼叶较大,头鞍的比例相对较小。

产地层位 湖南花垣排碧,中寒武统花桥组 *Ptychagnostus punctuosus* 带。

科未定 Family uncertain

卢氏盾壳虫(新属) Genus *Luaspis* gen. nov.

模式种 *Luaspis decorosa* gen. et sp. nov.

特征 头盖强烈凸起(纵、横向),壳面光滑。背沟微弱,头鞍大,占据头盖的绝大部分。颈沟消失,无鞍前区。眼叶极小,位于头盖中部。前边缘宽平。尾轴宽而长,有短的轴后脊,肋区窄而光滑。

讨论 我国寒武纪三叶虫中迄今尚未发现与新属相似的属。新属与北美和澳大利亚 Blountiinae 亚科的 *Blountia* Walcott (1916,p. 396)及其亚属 *Blountia* (*Mindycrusta*) Öpik (1967,p. 234)有些相似,特别是与产于格陵兰中寒武统 Holm Dal 组的 *Blountia bella* Robison (1988,p. 54,figs. 13. 5,8—12)在头盖形态上十分相近。不同的是 *Blountia* 和 *B.* (*Mindycrusta*)的头盖凸起(纵向)较弱,头鞍比例相对较小,外边缘较窄(纵向)较凸起,具有鞍前区,眼叶也较远离头鞍。此外,后两者在面线前支的历程和后侧翼的形态方面也与新属不同。

时代分布 湖南花垣,中寒武世 *Lejopyge laevigata* 带上部至晚寒武世。

华美卢氏盾壳虫(新属、新种) *Luaspis decorosa* gen. et sp. nov.

(图版Ⅵ,图1—9)

特征 与属征相同。

描述 头盖亚方形,强烈凸起(纵、横向),长度大于后缘的宽度。头鞍肥大,中后部近于平行,在眼叶之前徐缓向前收缩,前端圆润,伸达前边缘沟。背沟浅,在眼叶之前变得十分微弱。颈沟仅在幼小个体上存在(图版Ⅵ,图5,6),极浅,两侧不与背沟相连,成年期颈沟消失;颈疣在幼年期显著,位于颈环中部,成年后则较不明显,位于头鞍包括已融合的颈环后1/10处。眼叶极小,稍歪斜,位于头鞍中线附近,贴近头鞍,包围一极窄的固定颊眼区。无鞍前区;外边缘平,略向前倾斜;前边缘沟浅,宽弧形。眼前区小,亚三角形。面线前支自眼叶前端微扩张前伸,越过前边缘沟后逐渐内转,呈弧形越过外边缘;后支作向外拱曲的弧形,包围亚梯形的后侧翼。后侧翼横向宽度仅为头鞍基部宽的1/4;后边缘沟浅而清楚,后边缘平凸,由内向外变宽(纵向)。

尾部半圆形,宽约为长的0.7。中轴宽锥形,适度凸起,前缘宽度稍小于肋区宽度。表面光滑,表皮剥落后隐约分为4个轴节和1个末节,末端尖,向后延伸出一短的轴后脊,伸达边缘沟。肋区不分节,适度凸起,向外高度降低。边缘沟宽浅,边缘平或微凸起,中等宽度。向后微变宽。

产地层位 湖南花垣排碧中寒武统花桥组 *Lejopyge laevigata* 带顶部至上寒武统车夫组底部。

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NEW POLYMERID TRILOBITES FROM MIDDLE CAMBRIAN HUAQIAO FORMATION OF WESTERN HUNAN*

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Summary

The Jiangnan Slope Belt (Peng, 1992) in western Hunan is known as one of the most richly fossiliferous areas in China for Middle Cambrian trilobite faunas, yielding abundant polymerids as well as agnostids. The Middle Cambrian trilobite faunas of this area have been recorded previously by Jegorova and others (1963), Liu (in Zhou *et al.*, 1977; 1982) and Yang (1978). New investigations to the Cambrian sequence of this area have been carried out by the present authors in recent years. As a result of the investigations, a large col-

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lection of Cambrian trilobites has been obtained, in which many of the unreported taxa have been recognized. The purpose of this paper is to document some of the new Middle Cambrian polymerids.

The material described here were collected during 1981 and 1985—1991 from the Huaqiao Formation of two sections measured at Paibi, Huayuan and near Wangcun, Yongshun respectively, including seven new species assigned to seven genera: *Changqingia laevis* sp. nov., *Fissanomocarella paibiensis* gen. et sp. nov., *Huayuania subcalva* gen. et sp. nov., *Luaspis decorosa* gen. et sp. nov., *Paranomocarella fortis* sp. nov., *Wangcunia wangcunensis* gen. et sp. nov. and *Zhujia hunanensis* sp. nov.

The Middle Cambrian of the Jiangnan Slope Belt, in which the measured sections are situated, are divided into two formations, the Aoxi Formation below and the Huaqiao Formation above. No trilobites have been found as yet from the Aoxi Formation because it consists mainly of dolomites. The Huaqiao Formation, however, is richly fossiliferous, from which the Middle Cambrian trilobites in this paper are recorded. This formation consists mainly of dark grey, thin, parallel-bedded, laminated argillaceous limestone, which bears limestone lenses usually, with intercalations of light grey, thin to medium-bedded limestone. The Huaqiao Formation in Paibi section bears several intercalations of medium-bedded to massive limestone breccia, showings great difference from that in Wangcun section. Nevertheless, the biostratigraphical successions of the Huaqiao Formation in both Paibi and Wangcun sections are identical, with 4 trilobite zones based on agnostid species currently recognized in ascending order as: 1) *Ptychagnostus atavus* Zone, 2) *Ptychagnostus punctuosus* Zone, 3) *Goniagnostus nathorsti* Zone and 4) *Lejopyge laevigata* Zone.

With the exception of *Luaspis decorosa*, all the new taxa described here have their closest affinities to the Middle Cambrian faunas of North and southern Northeast China and are stratigraphically limited within the Huaqiao Formation. *Luaspis decorosa* ranges from the uppermost of the Huaqiao Formation upward into the basal part of the succeeding Chefu Formation which is earliest Late Cambrian in age, but its phyletic affinities still remains unclear.

SYSTEMATIC PALAEONTOLOGY

Descriptive terminology used herein follows Moore (1959), where possible, with additional terms *paradoublural line* and *baccula* (*-ae*) following Henningsmoen (1960) and Öpik (1967).

? Family Papyriaspididae Whitehouse, 1939

Genus *Wangcunia* gen. nov.

Type species *Wangcunia wangcunensis* gen. et sp. nov., designated herein.

Etymology From Wangcun, a town south of Yongshun County, western Hunan, near

which the type material is found.

Diagnosis A genus tentatively assigned to Papyriaspididae, characterized by the relatively large-sized glabellar, the narrow preglabellar field, the subparallel anterior sections of facial sutures and the multisegmented pygidium as long (sg.) as cranidium.

Remarks Öpik (1961, p. 149) characterized Papyriaspididae as a group of multisegmented ptychopariacids. The only dorsal exoskeleton specimen in hand with 8 thoracic segments is here considered as an immature form based on its smaller size, and therefore, the number of thoracic segments in the new genus still remains unclear at the moment. *Wangcunia* is questionably assigned to the Papyriaspididae based on its cranidial morphology, which shows a close similarity to those of papyriaspidids such as *Papyriaspis* Whitehouse, 1939, *Pianaspis* Saito et Sakakura, 1936, *Prohedinia* Lermotova et Tchernysheva, 1950 and *Tosotychia* Öpik, 1961, and on the multisegmented pygidium.

The new genus differs primarily from all other genera currently referred to Papyriaspididae in the large-sized and multisegmented pygidium and in the proportionally larger glabella with sharp-rounded rather than truncated anterior end and shorter (sag.) preglabellar field. In cranidium, it is reminiscent of *Wandelella* Robison (1988, p. 98), but the latter differs in having a longer preglabellar field and smaller palpebral lobes, and it is readily distinguishable in the relative size, segmentation and pleural structure of the pygidium.

Age and distribution *Ptychagnostus punctuosus* Zone, Middle Cambrian, western Hunan.

Wangcunia wangcunensis gen. et sp. nov.

(Pl. I, figs. 1—11, 12b, 13)

Diagnosis The same as for the genus.

Description Cranidial length (sag.) a little smaller than width between palpebral lobes. Glabella of moderate convexity, slightly tapering forward, acutely rounded anteriorly. Glabella plus occipital ring occupying 0.78—0.84 of the total cranidial length. Four pairs of lateral glabellar furrows weakly to moderately developed; preoccipital furrows deeply incised, slightly sigmoid or straight, gently oblique rearward; 2P furrows weakly indicated, slightly oblique rearward; 3P and 4P furrows very faint, transverse to slightly oblique forward and oblique forward respectively. Occipital furrow deeply incised laterally, shallowing medially. Occipital ring with median node lying before the midpoint, close to the occipital furrow. Palpebral lobe of moderate size with posterior end opposite preoccipital furrow. Ocular ridge prominent, straight or slightly curved and gently extending rearward. Palpebral area flat, with a width equal to or slightly greater than half that of glabella. Anterior border narrow, gently downsloping to slightly upturned, sharply pointing laterally, with broad (tr.) and short (sag.) plectrum. Anterior border furrow bearing a row of fine,

irregular pits. Preglabellar field slightly longer (sag.) than anterior border. Anterior sections of facial sutures subparallel initially from anterior ends of palpebral lobes. Posterior sections gently sinuous, enclosing triangular posterolateral limbs. Librigena with slightly advanced genal spine. Hypostoma subtriangular in outline with well upturned anterior border and narrow lateral and posterior borders. Rostral plate present.

Thorax at least of 8 segments. Pleural tips pointed in the first 3 segments but shortly spinulose in those behind.

Pygidium semielliptical, multisegmented, as long (sig.) as cranidium, with transverse anterior margin and acutely rounded anterolateral angle. Axis slightly tapering rearward, extending to posterior border, with 11—13 rings and a terminal piece markedly elevated. Pleural field wide, bearing straight, broad and shallow pleural furrows and narrow and weak interpleural furrows. Lateral and posterior borders narrow and flat. Posterior margin with anterior curvature.

Occurrence *Ptychagnostus punctuosus* Zone, Huaqiao Formation; Wangcun section, Yongshun, western Hunan.

Family Solenopleuridae Angelin, 1854

Genus *Changqingia* Lu et Zhu, 1983

1983 *Changqingia* Lu et Zhu in Qiu *et al.*, p. 104.

1987 *Austrosinia* Zhang et Jell, p. 91.

Type species *Changqingia shandongensis* Lu et Zhu in Qiu *et al.*, 1983, by original designation.

Other species Those referred to *Austrosinia* by Zhang and Jell (1987, p. 92) are here reassigned to *Changqingia*. In addition, *Solenoparia lata* Ivshin (1953, p. 109. pl. 7, figs. 21, 21a) and the paratypes of *S. suavis* Ivshin (*loc. cit.*, p. 102, pl. 7, figs. 1—3, 5—8, 15, *non* fig. 2) also may be referable to this genus. These paratypes may represent a new species.

Remarks Zhang and Jell (1978) recognized a new genus *Austrosinia* from the collection of the Smithsonian Institution, Washington D. C. The specimens of its type species, *S. chalcon* (Walcott, 1911, p. 83, pl. 16, fig. 5), are known from the Changhsia Formation of Changxingdao Island in southern Liaoning, bearing essential characters both in cranidium and in pygidium identical with the specimens from the same formation at Tai'an, Shandong, which had already been given a new generic name *Changqingia* earlier by Lu and Zhu in Qiu *et al.*, 1983. *Austrosinia* is a junior synonym of *Changqingia* as suggested by their morphology and geographic and their biostratigraphic distribution.

Age and distribution *Crepicephalina* Zone, North and Northeast China; *Goniagnostus nathorsti* Zone, western Hunan; and *Solenoparia* Zone, South Korea. Late Middle Cambrian, Australia and Kazakhstan.

Changqingia laevis sp. nov.

(Pl. Ⅱ, figs. 1—4)

Diagnosis Species of *Changqingia*, with relatively narrower (sag.) anterior border but no granulation on external surface.

Description Cranidium of moderate convexity. Glabella defined by deep axial furrow, acutely rounded anteriorly. Three pairs of lateral glabellar furrows weakly developed. Muscle scars thin, with preoccipital ones bifurcated. Occipital ring with small median node in front of midpoint. Palpebral lobe lying slightly posterior to cranidial midlength. Ocular ridge prominent, gently curved and oblique rearward. Anterior border narrow (sag.) and convex, narrowing abaxially. Preglabellar field as wide (sag.) as or slightly wider than anterior border, notably impressed, bearing broad (tr.), obscure median furrow. Anterior sections of facial sutures slightly convergent forward, while posterior sections nearly straight, strongly divergent rearward.

Remarks This is a species of *Changqingia* first recorded from South China. It differs from all the described species in having narrower (sag.) anterior border and anteriorly more acutely rounded glabella and in the absence of granulose ornamentation on external surface.

Occurrence *Goniagnostus nathorsti* Zone, Huaqiao Formation; Paibi section, Huayuan, western Hunan.

Family Anomocarellidae Hupè, 1953

Genus *Fissanomocarella* gen. nov.

Type species *Fissanomocarella paibiensis* gen. et sp. nov, designated herein.

Etymology From *Fiss*, Latin, split, chink and *Anomocarella*, generic name, referring to the anomocarellid-like cranidium combined with the two-pronged pygidium.

Diagnosis An anomocarellid genus with preglabellar field absent or extremely narrow; anterior border wide (tr.) and flat, bearing broad (tr.) and short plectrum; glabella with bacculae; occipital ring swollen posteriorly and obtusely angled rearward. Pygidium with lateral borders prolongated posterolaterally into broad-based spines.

Remarks The anomocarellid aspect of the new genus is apparent not only in cranidium but also in pygidium if the prolongations of borders are ignored. Nevertheless, it can be easily distinguished from *Anomocarella* and other genera in the Anomocarellidae as well, by the particular spinulose pygidium and the much more reduced preglabellar field.

In the unusual pygidium, the new genus is reminiscent of several genera with bilobed pygidium, such as *Hsuchuangia* Lu et Zhu in Qiu *et al.*, 1983, *Temnoura* Resser et Endo in Kobayashi, 1935, *Koptura* Resser et Endo in Kobayashi, 1935, *Parakoptura* Guo et Duan,

1978, *Lianglangshania* Zhang et Wang, 1985 and *Teratokoptura* Xiang et Zhang, 1985. All these genera, however, differ in having a shorter and thicker pygidial axis, proportionally narrower pleural fields bearing no paradoublural line, backward rather than backward and outward prolongated lateral borders, and hence a different outline.

The pygidia assigned to *Haniwoides* by Shergold (1980, pl. 33, figs, 6—9) and Kobayashi (1962, pl. 3, figs, 20—22) respectively resemble that of the new genus in the outline and the proportion of axis, but none of them has a similar pleural structure as in the new genus. In addition, the cranidium of *Haniwoides* differs greatly in having preoccipital median tubercles.

Age and distribution Middle Cambrian, *Ptychagnostus atavus* Zone, western Hunan.

Fissanomocarella paibiensis gen. et sp. nov.

(Pl. Ⅱ, figs. 5—11; Pl. Ⅲ, figs. 1—3)

Diagnosis The same as for the genus.

Description Cranidium subquadrate. Glabella considerably convex, parallel-sided, well rounded anteriorly, with a pair of subtriangular bacculae. Four pairs of shallow lateral glabellar furrows developed, with the preoccipital furrows bifurcated. Occipital ring triangular in outline, bearing a subcentered median node and a pair of weak, outward and rearward oblique furrows which isolate a pair of lateral lobes from the tumid main part of the occipital ring. Anterior and posterior ends of palpebral lobe opposite to 2P glabellar furrow and the midpoint of preoccipital lobe respectively. Palpebral area of fixigena slightly convex, one-third as wide as glabella. Preglabellar field absent or extremely narrow. Anterior border wide (sag.) and even, slightly upturned, depressed sagittally and posteriorly with broad (tr.) and short plectrum against glabella. Anterior sections of facial sutures divergent forward at an angle of about 50°. Posterior sections gently sinuous, strongly divergent rearward.

Pygidium subrectangular, with parallel lateral margins. Axis well defined and weakly segmented, with 6—7 rings and a semicircular terminal piece extending slightly beyond paradoublural line developed as semicircular thick ridge defined anteriorly by prominent furrow. Pleural fields gently convex and downsloping outward. Lateral and posterior borders differentiated from pleural fields by obscure furrows and by marked change of slope. Lateral border prolongated and upturned into broad-based spines.

Cranidium and pygidium having a prosopon of fine, well dense wrinkles.

Occurrence *Ptychagnostus atavus* Zone of Huaqiao Formation; Paibi section, Huayuan, western Hunan.

Genus *Paranomocarella* Yang, 1977

Type species *Paranomocarella parallela* Yang, 1977, by original designation.

Other species *Paranomocarella parapolita* Yang, 1978 (p. 54, pl. 9, figs. 4—6), *P. transversa* Yang et Lin, 1992 (in Yang *et al.*, 1992, p. 161, pl. 19, figs. 9, 10), *P. pujiabaensis* Yang et Lin (*loc. cit.*, figs. 11, 14) and *Anomocarella zhejiangensis* Ju, 1983 (in Qiu *et al.*, p. 154, pl. 50, figs. 1, 2).

Remarks Yang (1978, p. 53) considered *Paranomocarella* as different from *Anomocarella* in the presence of lateral glabellar furrows and in having caecate preocular fields and broader pygidial borders bearing pleural furrows. However, the refigured material of *Anomocarella* from North China (Zhang and Jell, 1987) suggests that these differentiated features are doubtful or of little value. *Paranomocarella*, as a separate genus in Anomocarellidae, could be better characterized by its low convexity, small palpebral lobes lying close to glabella, proportionally small-sized glabella, well-developed plectrum, well-furrowed pleural fields and well-indicated paradoublural line.

Paranomocarella closely resembles *Gangdeeria* Zhang et Yuan, 1980 (in Zhang *et al.*, p. 75) from the Middle Cambrian Hsuchuang Formation of the Zhongtiao Mountains area in southern Shanxi. Examination on the types of *G. neimengguensis*, the type species of *Gangdeeria*, revealed that the holotype cranidium (*loc. cit*, pl. 8, fig. 10) seems to be an immature specimen, while the paratype cranidium and pygidium (*loc. cit*, figs. 11, 12) are extremely similar to those of *Paranomocarella*, especially in the convexity of cranidium, the shape, proportion and sinuous flanks of glabella, the wide, plectrum-bearing preglabellar area and the structure and segmentation of pygidium. *Gangdeeria* is probably synonymous with *Paranomocarella*, but it is preferable to make a final conclusion until more material from Shanxi is possible.

Age and distribution Middle Cambrian, *Ptychagnostus atavus* Zone to *Lejopyge laevigata* Zone, western Hunan; *Linguagnostus wanyuanensis-Paranomocarella* Zone, northeastern Sichuan.

Paranomocarella fortis sp. nov.

(Pl. Ⅰ, fig. 12a; Pl. Ⅲ, figs. 4—13; Pl. Ⅳ, figs. 1—4)

Diagnosis Species of *Paranomocarella* characterized by a large anterior area with flat and elevated anterior border, a strong plectrum, and a transverse pygidium.

Description Cranidium of low convexity. Glabella parallel-sided with slightly sinuous flanks and a weak median keel, well rounded anteriorly, occupying 0.74 of total cranidial length (including occipital ring). Two pairs of lateral glabellar furrows developed as shallow impression commonly in large specimens (4 pairs indicated in small individuals). Occipital furrow shallow medianly, slightly deepened near axial furrow, becoming extremely shallow abaxially. Occipital ring together with posterolateral part of glabella swollen laterally, bearing a centered median node. Palpebral area flat, one-third as wide as glabella. Palpebral lobe lying posterior to cranidial midlength. Ocular ridge short, strongly oblique

rearward. Anterior border flat, elevated above preglabellar field, with stout plectrum. Preglabellar field as wide (sag.) as anterior border. Anterior sections of facial sutures strongly divergent forward; posterior sections transverse, enclosing narrow (exsag.) and long strap-like posterolateral limbs. Librigena having wide lateral border, shallow lateral border furrow connecting with posterior one at genal angle. Genal spine having wide base continuing from borders. Librigenal doublure defined anteriorly by oblique connective suture isolating rostral plate. Hypostoma having forward curved anterior margin, large, elliptical anterior lobe of median body and crescentic posterior one, strongly downward-bent anterior wings, and ridge-like lateral border.

Pygidium semicircular in outline, moderately convex, with flat articulating facets anterolaterally. Axis slender, well defined, with lateral sides slightly concave, having 7—8 rings and a semicircular terminal piece, reaching to paradoublural line and continuing rearward as postaxial ridge. Border furrows indicated by concavity of pleural area. Pleural furrows incised, becoming feeble beyond paradoublural line, not reaching to margins.

Remarks The new species is similar to *P. pujiabaensis*, but the latter differs in having a concave anterior border, a weaker and broader (tr.) plectrum and a semielliptical-shaped pygidium. The present pygidium closely resembles the paratype pygidium of *P. transversa*; the only difference lies in the more distinct abaxial parts of pleural furrows in the latter. As in *P. pujiabaensis*, the holotype cranidium of *P. transversa* can be distinguished also by the character of anterior border and plectrum.

Occurrence *Ptychagnostus atavus* Zone to lower part of *Lejopyge laevigata* Zone, Huaqiao Formation; Paibi section in Huayuan and Wangcun section in Yongshun, western Hunan.

Genus *Huayuania* gen. nov.

Type species *Huayuania sublaevis* gen. et sp. nov., designated herein.

Etymology From Huayuan, a county in western Hunan.

Diagnosis A genus with all cranidial furrows except anterior border furrow moderately to largely effaced. Preglabellar field absent. Occipital ring having median node. Palpebral lobe rather large, located posteriorly. Broad anterior border slightly convex. Posterolateral limb of long blade. Librigena non-spinose. Pygidium semicircular with articulating facet. Pleural and ring furrows largely effaced. Axis raised with lateral side slightly concave and posterior end indenting paradoublural line. Except lateral glabellar furrows in cranidium, and pleural, lateral and posterior border furrows in pygidium, all furrows well indicated in exfoliated shell.

Remarks The cranidium has a leiostegiid aspect, but the combination of cranidial and pygidial features is more likely of an anomocarellid. The new genus is now questionably assigned to Anomocarellidae as the absence of preglabellar field, the evidently tapering

glabella, the non-spinose librigena and the effacement may prevent a definite assignment.

The cranidium resembles *Dazhuia* Yang et Lin (in Yang *et al.*, 1991, p. 154), a monotypic and poorly preserved genus from northeastern Sichuan, but the latter differs in having a flat and strongly upturned anterior border, a transverse anterior border furrow, and the well-defined axial furrows even in unexfoliated state. According to observation of Yang and Lin, *Dazhuia* has a median glabellar node lying at about two-thirds (65%) of glabellar sagittal length from the occipital furrow. However, the presence of such a glabellar node in an anomocarellid (or a lishaniid trilobite as assigned by Yang and Lin) seems to be doubtful. A reliable comparison can be made on this feature only until more material of *Dazhuia* has been obtained.

Age and distribution Middle Cambrian, *Lejopyge laevigata* Zone, north Hunan.

Huayuania subcalva gen. et sp. nov.

(Pl. Ⅳ, figs. 5—14; Pl. Ⅴ, figs. 1—6)

Diagnosis The same as for the genus.

Description Unexfoliated cranidium of moderate convexity, with a length to width ratio of 0.85—0.90 between palpebral lobes. Glabella slightly convex, tapering forward, anteriorly rounded, defined laterally by weak and slightly concave axial furrows. Lateral glabellar furrows absent. Occipital furrow faint. Occipital node prominent and centered. Palpebral area slightly downsloping outward. Palpebral lobe half as long (exsag.) as glabella. Ocular ridge feeble. Preglabellar field absent. Anterior border slightly upturned in earlier meraspis, gently convex, slightly downsloping forward to horizontal in later meraspis and holaspis, Anterior border furrow bent forward, well defined. Anterior sections of facial sutures divergent forward; posterior sections slightly sinuous, strongly divergent rearward, enclosing long (tr.), subtriangular posterolateral limbs. Librigena having gently convex genal field, wide lateral border, relatively narrower (tr., exsag.) posterior border, shallow lateral border furrow and faint posterior border furrow. Genal angle acutely rounded; genal spine lacking.

Pygidium semicircular in outline, moderately convex with articulating facets anterolaterally. Axis conical, with slightly concave sides; terminal end well posterior to weakly developed paradoublural line. Ring furrows nearly completely effaced in unexfoliated state but well defined in exfoliated state, dividing axis into 7 rings and a subtriangular terminal piece. Pleural field convex, downsloping outward, smooth in holospis, but weakly furrowed in earlier meraspis. Borders flat or slightly upturned, differentiated from pleural field by marked change of slope. Exfoliated holaspid pygidium developed with no pleural and interpleural furrows. Doublure of moderate width, with concentric lirae.

Occurrence Middle part of *Lejopyge laevigata* Zone, Huaqiao Formation; Paibi section, Huayuan, western Hunan.

Family Proashaphiscidae Chang, 1963

Genus *Zhujia* Ju, 1983

Type species *Zhujia lubrica* Ju in Qiu *et al.*, 1983; by original designation.

Other species *Zhujia hunanensis* sp. nov. as described below.

Remarks *Zhujia* was assigned to Tsinaniidae by Ju (in Qiu *et al.*, 1983), but it is preferably assigned to Proashaphiscidae based on the morphology of exfoliated surfaces.

Zhujia is similar to *Lioparella* Kobayashi, 1937 (see Lu *et al.*, 1965, p. 168) from Middle Cambrian of North China, but the latter differs in having larger palpebral lobes, an anteriorly truncated glabella and a spinose pygidium.

Age and distribution Middle Cambrian, northern Zhejiang; *Ptychagnostus punctuosus* Zone, western Hunan.

Zhujia hunanensis sp. nov.

(Pl. V, figs. 7—10)

Diagnosis A *Zhujia* species with shallow axial furrows outlining glabella clearly. Glabella keeled. Anterior border furrow considerably bent forward. Anterior sections of facial sutures divergent. Cranidium with width (tr.) slightly greater at preglabellar area than at palpebral lobes.

Description Cranidium subquadrate in outline, moderately convex. Axial furrows shallow on unexfoliated surface and well defined in exfoliated state. Glabella of low convexity, tapering forward, obtusely rounded anteriorly, with a median keel sagittally and 4 pairs of faint lateral glabellar furrows, among which the preoccipital and 2P furrows long, oblique rearward; 3P pit-like, opposite to the midpoint of palpebral lobe, isolated from axial furrow; 4P also pit-lite, lying at anterolateral corner of glabella, close to axial furrow. Occipital furrow faint and straight. Occipital node centered. Palpebral lobe small, lying at about the midlength of cranidium. Palpebral area half as wide (tr.) as glabella, gently convex, slightly downsloping outward. Anterior border flat to slightly convex. Preglabellar field as wide (sag.) as anterior border, downsloping forward. Anterior sections of facial sutures gently diverging forward onto anterior border furrows, then turning inward and forward to cut straightly anterior border; posterior sections nearly straight, enclosing triangular posterolateral limbs.

Remarks The new species differs chiefly from *Zhujia lubrica*, the type species, in having relatively more developed axial furrows, hence a more outlined glabella, divergent rather than parallel anterior sections of facial sutures, and a less bent anterior border furrow.

The new species resembles *Lioparella walcotti* Kobayashi, 1937 (see Walcott, 1913, p. 191, pl. 18, figs 2d, e, *non* figs. 2, 2a—c and Zhang and Jell, 1987, pl. 66, fig. 14) in the

courses of the anterior sections of facial sutures, the structure of preglabellar area, the nature of ocular ridges and the keeled glabella, but the latter has larger palpebral lobes and an anteriorly truncated rather than rounded glabella. It is also comparable to *Zhuozishania typica* Zhang et Yuan (1981, p. 167, pl. 3, figs. 1, 2), which is now reassigned to *Lioparella* by Zhang and Jell (1987, p. 160), but the latter differs in having a wider (sag.) preglabellar field, larger palpebral lobes and a proportionally smaller glabella.

Occurrence *Ptychagnostus punctuosus* Zone, Huaqiao Formation; Paibi section, Huayuan, western Hunan.

Family uncertain

Genus *Luaspis* gen. nov.

Type species *Luaspis decorosa* gen. et sp. nov., designated herein.

Etymology From Lu, in honour of Prof. Lu Yanhao, and *aspis* (f.) Latin, meaning shield, carapace.

Diagnosis Cranidium considerably convex (sag., tr.). Glabella large, parallel-sided, occupying most part of cranidium. Occipital completely effaced in holaspis. Occipital node developed. Preglabellar field absent. Anterior border wide (sag.), horizontal to slightly downsloping forward. Palpebral lobe very small, lying at about the midlength of cranidium, close to axial furrows. Pygidial axis broadly conical, ending as postaxial ridge indenting posterior border. Pleural area smooth.

Remarks The phyletic affinities of the new genus are unknown. To our knowledge, there are no Chinese polymerids from Middle Cambrian resembling the present genus. Morphologically, it is more or less comparable to blountiinids, such as some species of *Blountia* Walcott, 1916 and *Blountia* (*Mindycrusta*) Öpik, 1967, especially *Blountia bella* Robison (1988, p. 54, fig. 13. 5, 8—12). Both *Blountia* and *Blountia* (*Mindycrusta*), however, can be distinguished by the presence of preglabellar field and by having a lower convex cranidium, a proportionally smaller, tapering rather than parallel-sided glabella, a relatively narrower (sag.) but more convex anterior border, more widely placed palpebral lobes, and more divergent anterior and posterior sections.

Age and distribution *Lejopyge laevigata* Zone of Middle to early Late Cambrian, western Hunan.

***Luaspis decorosa* gen. et sp. nov.**

(Pl. Ⅵ, figs. 1—9)

Diagnosis The same as for the genus.

Description Cranidium subrectangular in outline, considerably convex (sag., tr.), with a length greater than the maximum width at posterior margin. Axial furrow shallow. Glabella very large and tumid, subparallel-sided, obtusely rounded anteriorly. Occipital fur-

row faintly developed in meraspis but absent in holaspis. Occipital node prominent in meraspis and faint in holaspis. Palpebral lobe small, lying at midlength of cranidium or right in front of that of glabella, separated from axial furrow by very narrow palpebral area. Anterior border flat and wide (sag.), horizontal to slightly downsloping forward. Preglabellar field absent. Anterior sections of facial sutures slightly divergent forward, curving inward after crossing anterior border furrow; posterior sections slightly sigmoid, moderately divergent rearward, enclosing subtriangular posterolateral limbs. Posterior border furrow shallowing abaxially.

Pygidium semicircular in outline, 0.7 as long as wide. Axis broadly conical, moderately convex, with anterior width nearly equal to that of pleural area, bearing straight to slightly concave flanks. Axis completely effaced in unexfoliated state, but weakly furrowed when exfoliated with 4 rings and a triangular terminal piece continuing as postaxial ridge onto border. Pleural field unfurrowed, gently convex, with outer part downsloping outward. Borders slightly convex, widening rearward; border furrow shallow.

Occurrence *Lejopyge laevigata* Zone, Huaqiao Formation to basal part of Chefu Formation (Upper Cambrian); Paibi section, Huayuan, western Hunan.

图 版 说 明

所有标本均保存于中国科学院南京地质古生物研究所。采集号前冠以 HP 的标本产于湖南花垣排碧剖面;冠以 YW 的,产于永顺王村剖面。除注明者外,其余均产于中寒武统花桥组。

图 版 I

1—11, 12b, 13. *Wangcunia wangcunensis* gen. et sp. nov.

1. 头盖,×6。2. 严重压碎的不完整头盖,×3, holotype。3. 近于完整的活动颊,图 7b 外模标本的橡胶铸模,×8。4. 近于完整的背壳,×5。5. 不完整头盖,×8。6. 不完整头盖,×8。7. 附着在腹边缘板上的唇瓣(a)及破碎的活动颊(b),×6。8. 唇瓣,×8。9. 尾部,×5。10. 尾部,×3。11. 尾部,×2。12b. 尾部,×3。13. 尾部,×5。

采集号:YW56.7; 登记号:118804—118814, 118816, 118817。层位:*Ptychagnostus punctuosus* 带。

12a. *Paranomocarella fortis* sp. nov.

头盖,×3。采集号:YW56.7; 登记号:118815。层位同上。

图 版 II

1—4. *Changqingia laevis* sp. nov.

1. 表皮近于完全剥落的头盖,背视(a)和前侧视(b),×8, holotype。2. 表皮剥落的头盖,×8。3a, b. 表皮剥落的头盖,×6,背视,前视,×6。4. 表皮剥落的破碎头盖,×6。

采集号:HP17a; 登记号:118818—118821。层位:*Goniagnostus nathorsti* 带。

5—11. *Fissanomocarella paibiensis* gen. et sp. nov.

5a, b. 头盖,×5,背视,侧视。6. 头盖,×5。7. 不完整头盖,×3。8. 头盖,×4, holotype。9. 共生的两个尾部,×3。10. 尾部,×2。11. 尾部,×6。

采集号:HP14; 登记号:118822—118828。层位:*Ptychagnostus atavus* 带。

图 版 Ⅲ

1—3. *Fissanomocarella paibiensis* gen. et sp. nov.

1a,b. 头盖,×5,背视,侧视。2. 破碎尾部的橡胶铸模,×2,腹视,显示腹边缘。3. 尾部,×3。

采集号:HD14;登记号:118829—118831。层位:*Ptychagnostus atavus* 带。

4—13. *Paranomocarella fortis* sp. nov.

4a,b. 头盖,×3,holotype。5. 头盖,×5。6. 表皮剥落的活动颊,×3。7. 头盖,×4。8. 不完整头盖,×3。9. 表皮部分剥落的活动颊,×4,橡胶铸模。10. 头盖,×3。11. 唇瓣,×6。12. 活动颊,×3,橡胶铸模,腹视。13. 头盖,×3,橡胶铸模,腹视。13. 头盖,×3。

采集号:图10为HP19,图12为HP14,其余均为HP17;登记号:118832—118841。层位:*Lejopyge laevigata* 带。

图 版 Ⅳ

1—4. *Paranomocarella fortis* sp. nov.

1. 尾部,×1.5,橡胶铸模。2. 尾部,×2。3. 尾部,×2,橡胶铸模。4. 尾部,×2。

采集号:图1为HP14,其余为HP17;登记号:118842—118845. 层位:图1为 *Ptychagnostus atavus* 带,图2—4为 *Lejopyge laevigata* 带。

5—14. *Huayuania subcalva* gen. et sp. nov.

5. 不完整头盖,×8。6. 表皮部分剥离的头盖,×10。7a—c. 表皮部分剥离的头盖,×5,前视、背视和前侧视,holotype。8. 表皮剥离的头盖,×8。9. 表皮部分剥离的尾部,×4。10. 活动颊,×5,橡胶铸模。11. 活动颊,×10,显示腹边缘前部。12. 活动颊,×10。13. 尾部,×4。14. 活动颊,×8。

采集号:HP22;登记号:118846—118855。层位:*Lejopyge laevigata* 带。

图 版 Ⅴ

1—6. *Huayuania subcalva* gen. et sp. nov.

1. 尾部,×10。2. 表皮大部剥离的尾部,×5。3. 表皮部分剥离的尾部,×6。4. 尾部,×6,橡胶铸模,腹视,显示腹边缘。5. 尾部,×10。6. 表皮部分剥离的尾部,×5。

采集号:HP22;登记号:118856—118861。层位:*Lejopyge laevigata* 带。

7—10. *Zhujia hunanensis* sp. nov.

7a—c. 表皮剥离的头盖,×4,侧视、背视、前视。8a,b. 头盖,×4,holotype,背视、侧视。9. 表皮部分剥离的不完全头盖,×4。10a,b. 表皮剥离的头盖(b)及其外模的橡胶铸模(a),×8。

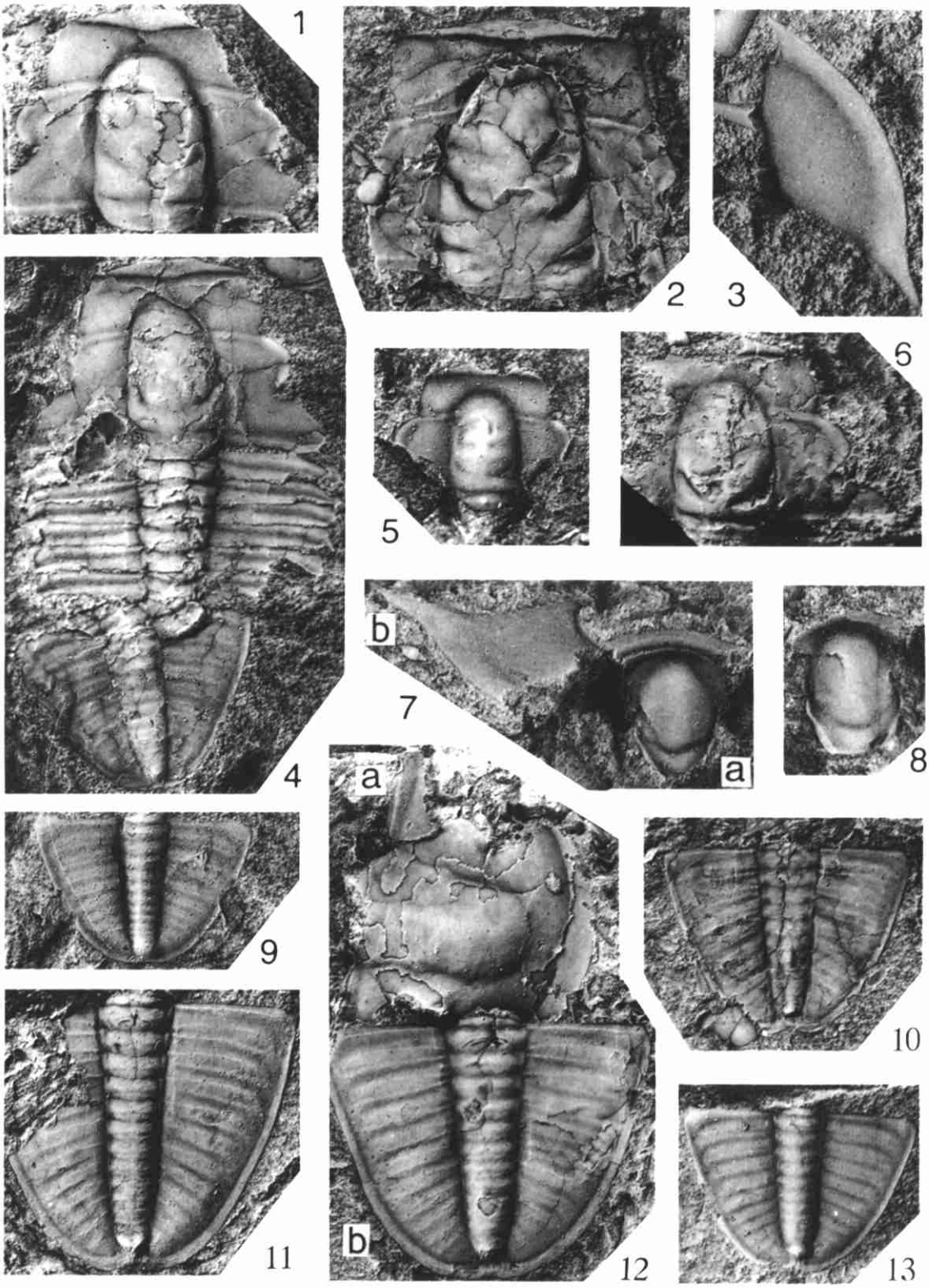
采集号:HP15c;登记号:118862—118865。层位:*Lejopyge laevigata* 带

图 版 Ⅵ

1—9. *Luaspis decorosa* gen. et sp. nov.

1a—d. 头盖,×5,背视,侧视,前视,后视。2a—c. 头盖,×4,holotype,侧视,背视,斜前视。3a—c. 头盖,×8,背视,后视(显示颈疣),前视。4. 头盖,×6。5. 头盖,×12。6. 头盖,×12。7. 头盖,×4。8. 表皮剥离的尾部,×8。9. 尾部,×6。

采集号:图1—8为HP27-3,图9为HP27d;登记号:118866—118874。层位:图1—8为 *Lejopyge laevigata* 带,图9为上寒武统车夫组底部。

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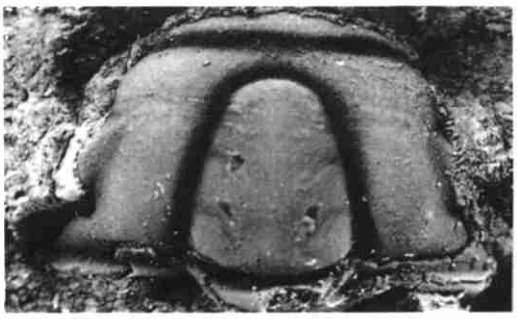
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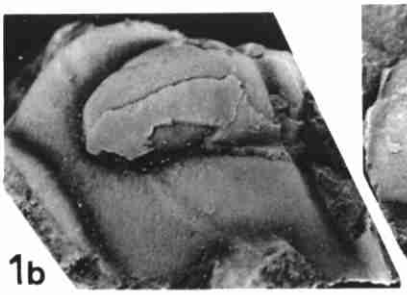
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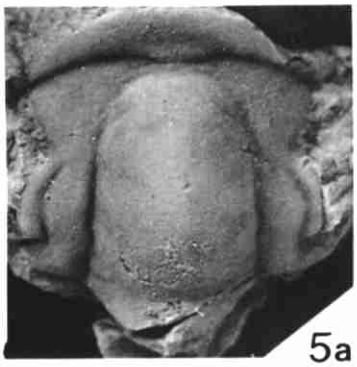
3a


3b


4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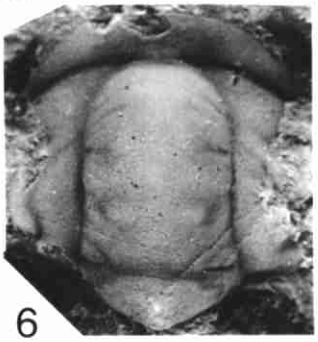
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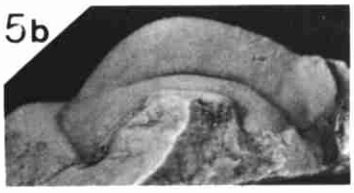
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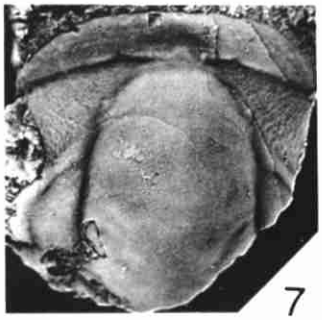
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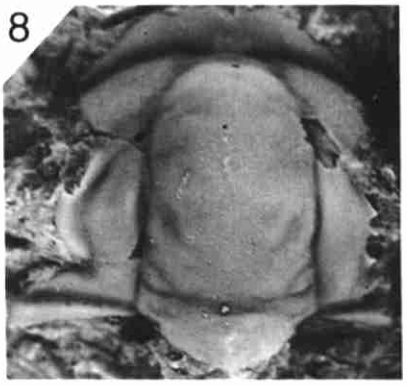
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